

Introduction to Milling =====

This induction covers the minimal basic items to allow safe use of the Bridgeport Mill. Machining in general and milling in particular is a complex subject, people take years to become an expert machinist, we have a couple of hours so there is a lot of simplification and missing out on details.

This introduction has a number of rules/guidelines that if followed will result in safe practices but may not be the best way to do any particular job, as you get better and understand more you will probably find better ways to do things but you should not bypass anything here unless you understand why the rule is here and why it is ok to do it differently.

Safety - Yours and the Machines
Main dangers in using the mill are:-
To you.
Hot flying chips.
Fingers/clothes caught in the machine.
Cuts from sharp milling tools.
Poorly held work moving/jamming
Tools breaking and becoming projectiles.

Mitigation:-
Safety glasses
no loose long sleeve clothing
Double check work holding
Double check tool holding/Security
Don't leave chuck key in
Don't leave the spanner on the draw bar
X handles when using auto feed
don't touch the swarf with bare hands (hot and sharp)
Always ensure cutter is well clear of everything before turning spindle on.
make sure free moving and clear (spin by hand)

To the mill
Breaking tools due to too heavy cuts
Cutting into the vice/table

Mitigation:-
Never leave the machine powered on and unattended.
If you use the power feeds (X or Z) triple check before engaging and be 100% sure
you know how to stop/disengage the feed. Check the feed speeds with a large air gap
before doing actual cuts, set the auto disengage stops before engaging the feed.
Only use the power feeds when you are completely comfortable with manual use of the mill.

Drilling in the Mill =====

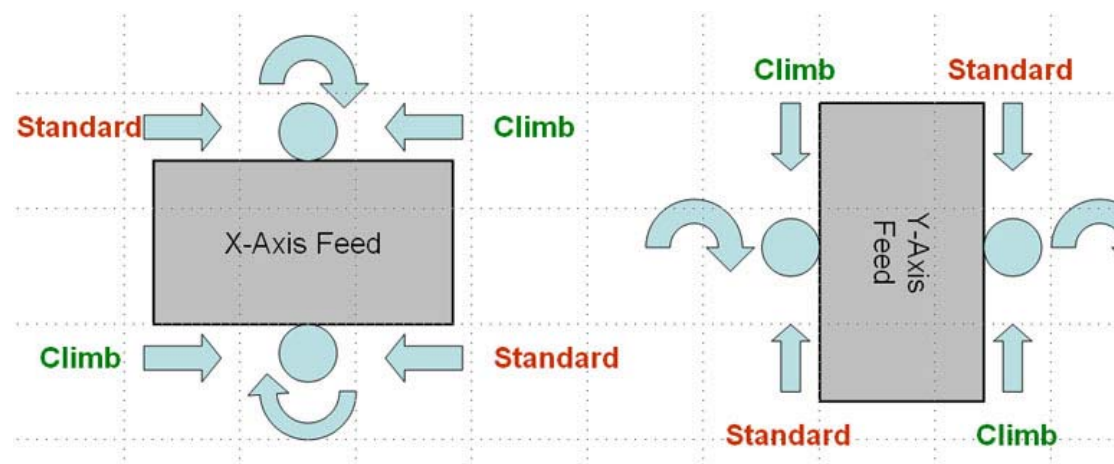
Main danger is drilling a hole in the vice/table - there is NEVER any excuse for doing this it is simple carelessness - DONT DO IT.

Milling =====

General rule on for milling is that cuts are made in X and Y directions NOT Z.
i.e. Cut across or along not down. If you need to cut down for a pocket or internal feature on your part its usually better to drill a hole first, if this is not possible then cut with combined down and cross movement. Note that many milling cutters will not cut at the center, i.e. they will not work as drills.

Conventional and Climb milling =====

The difference is the direction the work is cut in relation to the direction the tool is turning
conventional milling also calles standard is when the tool rotation direction is trying to push the work in the opposite direction to the way you are moving it to make the cut.



The bridgeport is relatively old and has some play in the X and Y feeds, this makes climb milling potentially dangerous in that it could cause jams and broken tools, so in almost all cases you should use conventional milling.

There are exceptions but they should be considered an advanced topic and if you don't know why you are doing it just ensure you are always cutting 'conventionally'.

Cutting Speed / Depth / Width

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Books have been written about this but most of the issues only arise when there is a need to do things quickly to minimise time taken/cost to produce a part. For 'hobby' use some simple rules of thumb work.

Spindle speed

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Speed depends on the material being cut and the size of the cutter. it's not an exact science and 'close enough' works ! as a starting point the table below gives some examples.

	Cutter Size (inches)		
	0.25	0.5	1
Plastic	4800	2400	1200
Aluminium	2400	1200	600
Brass	2080	1040	520
Mild Steel	1280	640	320
Cast Iron	1120	560	280

As you can see there are two rules, the harder the material the slower you go, the large the cutter the slower you go.

These numbers are for end mills, for drills around 1.5 times these speeds are close enough.

If you are not sure it's usually best to err slightly on the slower side than have the spindle too fast.

Depth and width of cut

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How deep and wide you can make a cut depend on the tool size and how well you can hold the work on the table.

A reasonable starting point is that Depth of cut should be less than twice the diameter of the tool, and width of cut should be less than half the diameter of the tool.

Speed of cut (aka how fast you turn the handles)

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This is very much a feel and listen thing, most people get a feel for it quite quickly.

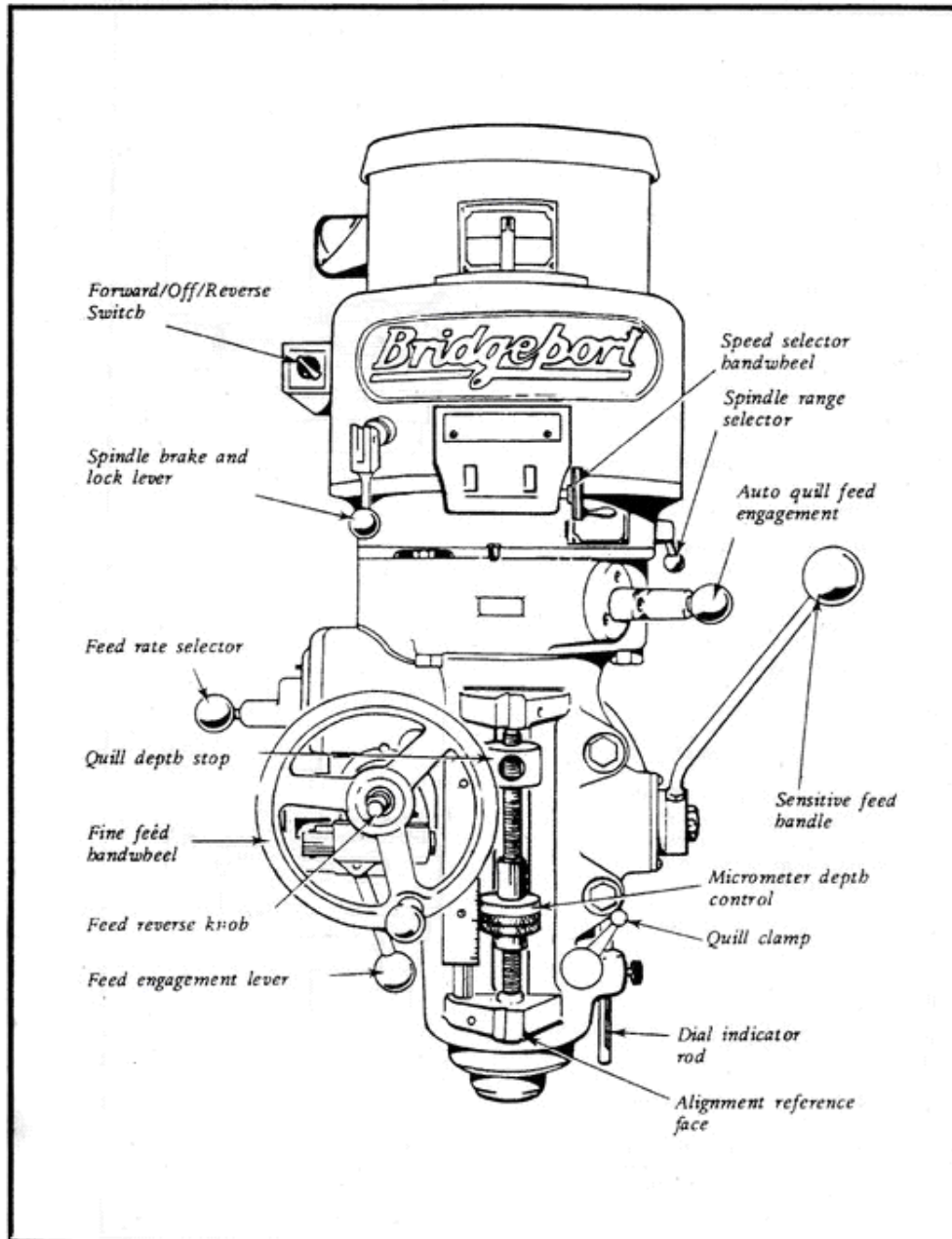
The complication in the above items is that they all interact but following the above guides initially will give a good starting point, change things slowly and see what happens.

Changes to each of these affect how fast the job gets done, and also how nice the surface finish is, how long the tool will last and how accurate the cut is.
For most 'hobby' jobs surface finish and accuracy is usually

most important and higher spindle speeds with lower depth of cut and speed of cut tend to improve these but higher spindle speeds make the cutting tool blunt faster so there is a trade off.

Bridgeport Induction
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Operation



2.3 2J2 - Head Controls

Following is mostly just notes of areas to be covered by the inductor. Also usefull for the Inductee to have a copy as a reference for later use.

Powering on the Machine

Location of Breaker

Power and Spindle direction controls

Spindle Speed

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Changing the belts to select the spindle speed
adjusting belt speed stop motor, stop motor & tension off,
adjusting belts, engaging back gears, tension on

Tool Mounting

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Collets, Chucks, Available cutting tools and how to hold them.
Drawbar, appropriate use of drilling chuck.

Mill Controls

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"Normal Setup Checks" - Initial position for controls

Worm Drive - Out

BackGear - As set for spindle speed

Z Auto feed controls

X,Y,Z movement Locks

X,Z Limit stops

Lubricator - Oil moving parts

DRO Initialised if required

Work Holding

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Vice / Clamps

Never appropriate to drill/cut on the bridgeport without
fixed workpiece - Hand held drilling - use a drill press.

Setting up / making cuts

Check area clear

Check travels are appropriate

Table locks for non moving axis

manual cuts

using the power feeds - setting stops

Types of cut - Surfacing, side milling

Types of cutter

Face Mill, End Mill, Fly Cutter, Drill

Chip removal/ Cutter Lubricant

Inductee Practice

Change Spindle Speed

Mount tool and workpiece
Surface a workpiece - Face Mill or fly cutter
Cut a slot